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ABSTRACT

This tool was designed for district officials and related policymakers interested in analyzing a district's spending patterns. It describes a three-step process that focuses on the distribution of resources among schools and types of students. The process is illustrated with an example from the Cincinnati Public Schools. The tool should enable district budget offices to combine and consolidate data so that a district's investment pattern is clear. The tool's key feature is that it relies on the conversion of dollar figures to an index that takes into account the kinds of students at the school. That means that the index measure is relative, allowing officials to compare spending levels at schools with different student populations. The measure contains no assumptions about the appropriate funding levels for different types of children but, rather, relies on a district's own total investment for each special program as the relative comparison. Results will enable districts to calculate a weighted average expenditure for each school and then, afterwards, interpret the weighted index. These findings will help districts compare funding levels for subgroups of schools and students, those elements that commonly drive funding inequities. (RJM)

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Assessing Inequities in School Funding within Districts

A Tool to Prepare for Student-Based Budgeting

School Communities that Work:
A National Task Force on the Future of Urban Districts

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School Communities that Work: A National Task Force on the Future of Urban Districts was established in 2000 by the Annenberg Institute for School Reform at Brown University to examine an element of the public education system that has often been overlooked: the urban school district. The primary goals of the Task Force are to help create, support, and sustain entire urban communities of high-achieving schools and to stimulate a national conversation to promote the development and implementation of school communities that do, in fact, work for all children.

To help imagine what high-achieving school communities would look like and how to create them, the Task Force convened influential leaders from the education, civic, business, and nonprofit communities to study three critical areas: building capacity for teaching and learning; developing family and community supports; and organizing, managing and governing schools and systems.

The following Task Force members guided the development of this article.

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Task Force leaders and funders are listed on the inside back cover.

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This tool was designed for district officials and related policy-makers interested in analyzing a district's spending patterns related to the distribution of resources among schools and types of students. The tool describes a three-step process and illustrates it with an example from the Cincinnati Public Schools (see sidebar).

In our analysis of several districts, we have found that most districts distribute resources unevenly among schools within the district that serve children with varying characteristics. Many of these inequities result from unplanned historic or programmatic causes, the sum of which, once revealed, is surprising to many district leaders. Most inequities are buried in complicated accounting procedures, antiquated staffing-based budgeting policies, and cost variations that accompany special student programs (such as bilingual education, special education, etc.). Some spending differences make sense, such as additional dollars for handicapped children, but others are not systematic and may even conflict with the district's stated goals.

The first step in beginning to act strategically about investing toward district goals is to examine how the district invests its resources – in which children and in which schools. Most district accounting procedures allow for examination of spending across functions (instruction, facilities, etc.) and items (core teachers, administrators, utilities, etc.). Some districts do report expenditures by school, but without some common reference to the kinds of children in the school, it is difficult to determine whether each school's funding level represents a justifiable amount or not.

Take, for instance, an elementary school, with a low poverty level and few bilingual or learning-disabled students, that receives $4,700 per student. A high-poverty elementary school with 44 percent limited-English-speaking students receives $4,900 per student. While the additional funds in the second school seem justified, one might ask if there are enough additional funds in the second school to cover both the bilingual education program and a comparable regular-education program. Do high-poverty students need additional dollars as well? Are they getting the appropriate amount? What about another high-poverty school that receives $5,600 per student? What about a magnet school that receives $6,500 per student?

CINCINNATI PUBLIC SCHOOLS

Cincinnati is a midsized district that at the time of this analysis was four years into a redesigned student-based distribution formula. The new formula was designed in part to address some of the inequities that surfaced in the analysis described in the example included in this tool. The data is from 1997–1998, just before the district implemented its major reform effort.

The Purpose of the Tool

The tool outlined here is designed to enable a district's budget office to combine and consolidate data so that the district's investment pattern is clear. The tool also allows leaders to analyze their expenditures in the context of equity. For these analyses, equity implies not equal funding for all students, but rather equal resources for similar children, with additional resources for special-needs students.

The key feature of this tool is that it relies on the conversion of dollar figures to an index that takes into account the kinds of students at the school. The index measure is relative and thus allows us to compare spending levels at schools with different

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student populations. The tool contains no assumptions about the appropriate funding levels for different types of children but, rather, relies on the district's own total investment for each special program as the relative comparison.

The three-step process described in the tool will yield information to answer a host of questions, including:

- How evenly are dollars distributed among different schools in the district?
- Do schools with more needy students get appropriately more resources? Do they have adequate funding for their special programs (such as bilingual education) in addition to a regular education program comparable to those of other schools in the district?
- How many (and which) schools are shortchanged in the budgeting process? How much variation exists – i.e., to what extent is there a problem?
- Are special-program dollars distributed evenly across the students that need them?
- Are there spending patterns that reveal different investments across schools of varying size, student demographics, school level, and region of the district?

A Guide to Using the Tool

The following three steps have been adapted for districts to use in clarifying their own spending patterns across schools and types of students. In order to use these tools, you will need

- the district's actual dollar expenditures for each school, and the total school expenditures for the district
- the district's expenditures for each category of special needs in each school (i.e., expenditures on special education in School A, expenditures on vocational education in School A, etc.)
- total enrollment in the district and in each school
- enrollment in each special program or student descriptor (including special education, bilingual education, vocational education, gifted status, poverty status, etc.) for each school

1. Compare funding levels across schools with different student populations

The first step in analyzing district spending variance is to convert actual dollar expenditures for each school to a *weighted index* (a ratio between two dollar amounts) that takes into account different district spending levels for students with varying characteristics. This measure allows comparison of funding levels across schools while accounting for differences in student populations. The index is a ratio of the actual expenditures at a given school to the average districtwide dollar expenditures for students with varying characteristics, weighted according to the particular mix of students at that school (i.e., *weighted average expenditure*).

Calculate a weighted average expenditure for each school

To calculate a weighted index, one must first calculate what the district expenditure for a given school would be if the school received the average amount the district spends on each category of students enrolled at that school, in the same proportions as at that school. To calculate the weighted average expenditure:

A. Multiply the total number of students in a particular school by the district's basic per pupil allocation.

B. Calculate the district's average *additional* per pupil expenditure for students in each category that is to be included in the analysis, such as bilingual students or high-poverty students. To demonstrate how to calculate that quantity, we use bilingual students as an example. Add all the district's bilingual expenses in all its schools and divide by the total number of bilingual students in all the district's schools.

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C. Multiply the district's average per pupil additional expenditure for students in a particular category (from step B) by the number of students in that category at that school. Add the result to the result from step A.

D. Repeat step C for each category of interest.

Note: The weighted average expenditure is different for each school because it reflects the district averages calculated for the particular categories and quantities of students at each school, not one average across the whole district. The district's average additional per pupil expenditure for each category "x" of students (PPE_x), on the other hand, is the same across the district, since it reflects the average amount the district spends across all the schools for students with a particular characteristic.

Calculate a weighted index for each school

Calculate the weighted index for each school as shown in Figure 1.

Interpret the weighted index

A school at the district "average" would show a weighted index of 1.0. That is to say, the school receives the basic allocation for each regular-education student at the school; the district's average additional special-education expenditure for each special-education student; the district's average additional vocational-education expenditure for each vocational-education student; etc. If this school has a high concentration of special-education students, it would indeed receive more actual dollars than many other schools, but still show a weighted index of 1.0 to reflect the fact that it receives the district average figure weighted for its particular mix of students.

$$\text{Weighted Index for School A} = \frac{\text{actual School A dollar expenditure}}{\text{weighted average expenditure for School A}}$$

where the

weighted average expenditure for School A =

$(N_{total} \times PPE_{basic}) + (N_{sped} \times PPE_{sped}) + (N_{voc} \times PPE_{voc}) + (N_{pov} \times PPE_{pov}) + (N_{ESL} \times PPE_{ESL})$

and

N_{total} = the total number of students in the school (including regular education and all other programs and categories)

PPE_{basic} = the district's basic per pupil allocation

N_x = the student population at School A for each category "x" of students

PPE_x = the district's average *additional* per pupil expenditure for each category "x" of students

Categories in this example:

sped = special education

voc = vocational education

pov = high-poverty

ESL = English as a Second Language

Figure 1 How to calculate a weighted index

An index greater than 1.0 indicates that the school receives more than the district's average allocation for the school's particular mix of students. An index of less than 1.0 indicates that the school receives less money from the district for the school's particular mix of students than is the norm for the district.

In districts we studied, weighted indexes ranged between 0.6 and 3.0. An index of 2.0 would indicate that a school receives twice the resources as the district averages would dictate for its mix of students. An index of 3.0 indicates three times the district average for its mix of students. An index of 0.5 indicates that the school receives half the district average funds for its mix of students.

The weighted index weights funding levels only for disenfranchised student groups, not for other funding disparities that may reflect the district's strategic choices (such as additional funding for middle school students, alternative schools, gifted students, etc.).

Graph the indexes

Graphing the indexes from lowest to highest allows for convenient examination of the range of variation.

Ask relevant questions

- What is the highest weighted index in the district?
- How much greater is it than the lowest index?
- Do most schools hover around the average, or are some far above or below the average?

		Number of schools	Percent of schools
Schools receiving less than 85% of the weighted average expenditure*	Index < .85		
Schools receiving 85% to 90% of the weighted average expenditure	Index = .85–.90		
Schools receiving 90% to 95% of the weighted average expenditure	Index = .90–.95		
Schools within 5% of the weighted average expenditure	Index = .95–1.05		
Schools receiving 105% to 110% of the weighted average expenditure	Index = 1.05–1.10		
Schools receiving 110% to 115% of the weighted average expenditure	Index = 1.10–1.15		
Schools receiving more than 115% of the weighted average expenditure	Index > 1.15		
Maximum index =			
Minimum index =			
Coefficient of variation =			

Figure 2 Analyzing the variation among schools

* Schools are categorized by their weighted index. Schools below the 85% funding level have a weighted index of 0.85 or less, etc.

2. Analyze how much variation there is among schools

This second step allows the district to examine the magnitude of variations in spending levels among schools and to pinpoint which schools receive more resources and which receive too few. This step also allows for comparison across districts and formulas.

Tally the weighted indexes

The first part of this step is to tally the weighted indexes (described above) for all schools in the district in a chart (see Figure 2 on page 4).

Calculate a coefficient of variation

The coefficient of variation provides a single number that indicates the relative range of the funding distribution. Once the weighted index for each school has been calculated, the coefficient of variation is determined from the set of weighted indexes:

$$\text{Coefficient of Variation} = \frac{\text{Standard Deviation (of the indexes)}}{\text{Mean (i.e., average, of the indexes)}}$$

See Appendix on pages 11 for definitions and formulas.

The coefficient of variation ranges from 0 to 1, with 0 being a uniform distribution that provides equal resources to similar students (i.e., all basic allocation dollars are distributed evenly among all students at all schools, all bilingual education dollars are distributed evenly among bilingual education students, etc.). This is a statistical measure that has been used to evaluate the distribution of funding levels among districts in a state; the standard for equity has been a coefficient of variation below 0.1. Districts can compare their measures over time and can also compare them with other districts. Deviations from a coefficient of variation of 0.0 may be justified for strategic reasons (such as a planned investment in the middle grades, etc.). However, districts should monitor how different distribution policies impact the coefficient.

Ask relevant questions

- How many schools receive less than 85 percent of the weighted average expenditure? Which schools are these?
- What percent of the schools receive less than 95 percent ?
- How many schools receive in excess of 115 percent of the weighted average expenditure? Which schools are these? Do the programs justify the extra expense? Do they produce greater results? What kinds of students benefit from these costly programs? How much money do these schools take away from other schools?
- How much would it cost to level up all schools to the weighted average expenditure?
- How has the coefficient of variation changed in recent years? Is the district moving toward greater equity?

3. Ask where the district is investing its dollars: who wins, who loses?

This framework allows a district to compare funding levels for subgroups of schools and students that commonly drive funding inequities.

Calculate an average weighted index for subgroups

After weighted indexes have been calculated for each school, a district can compare subgroups as indicated by the chart in Figure 3 on page 6. This is similar to the way all schools in the district were categorized in Figure 2, with the difference that indexes are averaged, coefficients of variation are calculated, and the number of schools varying from the weighted average expenditure are counted separately for each subgroup of schools. The categories on the chart in Figure 3 can be adjusted to reflect the student subgroups in the district being analyzed.

For each subgroup of the district's schools, calculate an average weighted index for that subgroup. For instance, for elementary schools, compare the average weighted index for all elementary schools. Then,

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		Average weighted index for this subgroup of schools	Coefficient of variation within this subgroup of schools	Number and percent of schools receiving over 110% of the weighted average expenditure within this subgroup of schools	Number and percent of schools receiving under 90% of the weighted average expenditure within this subgroup of schools
School Level, Type	Elementary				
	Middle				
	High				
	Alternative				
	Magnet				
School Size	Small				
	Medium				
	Large				
Special Student Populations	High-poverty schools				
	Low-poverty schools				
	Race/ethinic groups (break out into categories)				
	Gifted				
Region	North				
	South				
	Schools near district borders				
	Suburban				
	Urban				

Figure 3 Identifying schools and students in which the district invests the most and the least

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compute a coefficient of variation from the elementary schools' weighted indexes. Finally, look at the number and percent of elementary schools with weighted indexes greater than 1.1 and less than 0.9. These figures constitute one row of the table.

Interpret the results

The average index shows the average funding level for each group of schools. Districts might find, for example, that small schools have an average index of 1.12, whereas large schools have an average index of 0.96, indicating that where small schools benefit, large schools lose out.

The coefficient of variation indicates how much variation there is within any subgroup. For instance, a district may find that its low-poverty schools have an average index of 1.09 but that the coefficient of variation is high at 0.2, indicating that while wealthier schools are generally funded at higher levels, the pattern does not extend to all wealthier schools.

The numbers and percentages of schools over 110 percent and under 90 percent reveals how many schools are affected by the inequities.

Ask relevant questions

- What kinds of schools have the highest average weighted indexes? Why do these schools receive more resources? Do all schools of this type benefit (i.e., is there a low coefficient of variation indicating equal distribution across this type of school)?
- What kinds of schools have the lowest average weighted indexes? Do these students need fewer resources for some reason? Do these schools produce equal outcomes?
- Are there any unintended variations in funding levels (as indicated by average weighted indexes)?
- Which group of schools is most in need of funding reform? Which group of schools would likely lose out if the funding scheme were modified to reduce the variation?

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Example from the Cincinnati Public Schools

1. Compare funding levels across schools with different student populations

A weighted index was calculated for each of Cincinnati's seventy-seven schools. The distribution of the weighted indexes is displayed in Figure 4.

The weighted indexes ranged from 0.6 to 1.7, with very few schools receiving near the average. The school with the weighted index of 1.7 is allocated 70 percent more money than it would receive if it were allocated the district average amount for each of its students (including the average special-education expenditure for each of its special-education students, etc.).

At the other end of the distribution, the school with the least relative funding is allocated 40 percent less than the weighted average expenditure would dictate.

2. Analyze how much variation there is among schools

The coefficient of variation was calculated and the number of schools falling into each category was examined. The results are displayed in Figure 5 on page 9.

A coefficient of variation of 0.26 is very high and indicates substantial inequity among schools in the district.[1] With fewer than a quarter of the schools receiving within 5 percent of the weighted average expenditure, any redistribution would likely impact a large percentage of the district's schools. Substantial district dollars are being directed to the 26 percent of the schools (a total of twenty schools) being allocated funds in excess of 115 percent of the weighted average expenditure. These higher allocations mean fewer resources are available for the rest of the schools. A total of 29 percent of the schools (twenty-two schools) receive allocations at 90 percent or less of the average. These schools are the ones hurt most by the district's budgeting policies.

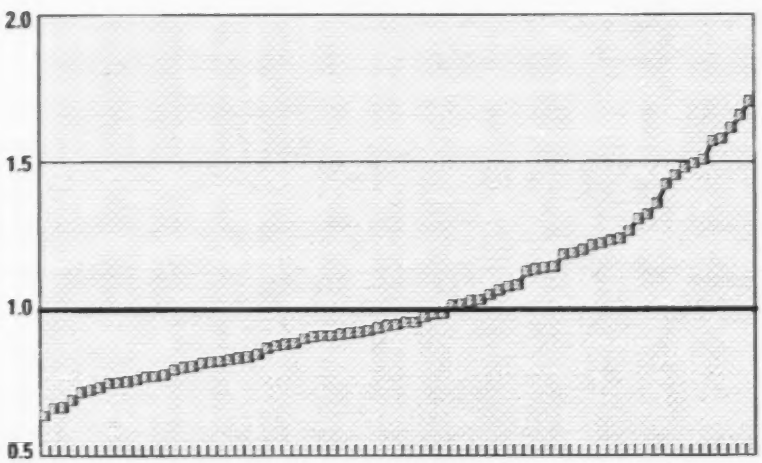

Figure 4 Cincinnati's weighted indexes showed a substantial variance from 0.6 to 1.7

Note: each box represents one school.

[1] Four years into Cincinnati's fiscal reform effort, the district's coefficient of variation was under 0.1.

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		Number of schools	Percent of schools
Schools receiving less than 85% of the weighted average expenditure*	Index < .85	10	13.0%
Schools receiving 85% to 90% of the weighted average expenditure	Index = .85–.90	12	15.6%
Schools receiving 90% to 95% of the weighted average expenditure	Index = .90–.95	8	10.4%
Schools within 5% of the weighted average expenditure expenditure	Index = .95–1.05	18	23.4%
Schools receiving 105% to 110% of the weighted average expenditure	Index = 1.05–1.10	6	7.8%
Schools receiving 110% to 115% of the weighted average expenditure	Index = 1.10–1.15	3	3.9%
Schools receiving more than 115% of the weighted average expenditure	Index > 1.15	20	26.0%
Maximum index = 1.7			
Minimum index = 0.6			
Coefficient of variation = 0.26*			

Figure 5 Analyzing the variation among schools in Cincinnati

* The high coefficient of variation reveals that under traditional budgeting policies, few schools receive allocations near the weighted average expenditure.

3. Ask where the district is investing its dollars: Who wins, who loses?

The weighted indexes were grouped by school type to yield the following patterns (see Figure 6 on page 10).

With higher average indexes for small schools than for large ones, we can tell that the district allocates proportionately more resources to small schools than to large ones (roughly 17 percent more). Magnet schools also receive more than their share of the funds, as do middle schools (which are allocated on average 30 percent more than other schools). A high coefficient of variation for the low-poverty schools indicates that the patterns for low-poverty schools do not extend to all schools in this category.

Questions that surfaced from these findings

This data raised many questions for Cincinnati officials. Among them:

- Can we justify taking money away from the 20–25 percent of schools funded at the highest level to raise the allocations for those at the lower end?
- Why is the district spending so much on our middle schools?
- Can the district justify the additional costs for magnet schools? Are these schools yielding higher results with comparable students?
- What can be done to improve results at some of our largest high schools?

	Average weighted index	Coefficient of variation	Percent of schools receiving less than 90% of the weighted average expenditure	Percent of schools receiving 110% or more of the weighted average expenditure
Small	1.07	0.17	9.1%	14.3%
Large	0.90	0.13	13.0%	1.3%
Magnet	1.17	0.15	0.0%	13.0%
Elementary	0.99	0.17	20.8%	11.7%
Middle	1.30	0.19	0.0%	7.8%
K–8	1.05	0.19	6.5%	7.8%
High	0.99	0.15	1.3%	1.3%
Less than 50% poverty	1.00	0.22	6.5%	3.9%
Greater than 75% poverty	1.00	0.19	13.0%	9.1%

Figure 6 Cincinnati's weighted indexes and coefficients of variation were grouped by school type

Appendix: Explanation of Mathematical Terms

MEAN

The mean of a distribution is the same as the "average." To calculate the mean, add all the scores and then divide that sum by the number of scores. The formula looks like this:

$$\frac{\Sigma X}{N_x}$$

where X represents each individual score in a distribution and N_x represents the number of scores in the distribution.

STANDARD DEVIATION

The standard deviation provides information about the spread of the distribution of scores. A small standard deviation tells you that the scores are tightly grouped around the mean. A larger standard deviation tells you that there are more extreme scores. The standard deviation can point you in the right direction if you want to understand why a distribution is the way it is. The standard deviation is calculated using this formula:

$$\text{Standard Deviation} = s = \sqrt{\frac{\Sigma (X - \bar{X})^2}{N - 1}}$$

Example

Consider a simplified, hypothetical case to illustrate the calculations. A school gives a certain test to two classes of four students each. The teacher of each of the classes reports an average score on the test of 82. Is the students' performance equally satisfactory in both classes? The standard deviation gives more information than the average score alone; it shows how much variation there is around the average.

Calculation of standard deviation:

For each classes:
Average ($\bar{X}$) = 82,
N (number of student scores) = 4

1. Subtract the average score from each of the student scores from Class A and square the result.

Class A	Student Scores (X)	$(X - \bar{X})^2$
Student 1	82	$(82 - 82)^2 = 0$
Student 2	78	$(78 - 82)^2 = 16$
Student 3	87	$(87 - 82)^2 = 25$
Student 4	81	$(81 - 82)^2 = 1$

2. Add the results from step 1.

   $\Sigma (X - \bar{X})^2 = 42$

3. Divide the result from step 2 by one less than the total number of scores.

$$\frac{\Sigma (X - \bar{X})^2}{N - 1} = \frac{42}{3} = 14$$

4. Take the square root of the result. This is the standard deviation for Class A.

$$s = \sqrt{\frac{\Sigma (X - \bar{X})^2}{N - 1}} = \sqrt{14} = 3.74$$

5. Repeat the calculation for Class B.

Class B	Student Scores (X)	$(X - \bar{X})^2$
Student 1	68	$(68 - 82)^2 = 196$
Student 2	66	$(66 - 82)^2 = 256$
Student 3	96	$(96 - 82)^2 = 196$
Student 4	98	$(98 - 82)^2 = 256$

$\Sigma (X - \bar{X})^2 = 904$

$$\frac{\Sigma (X - \bar{X})^2}{N - 1} = \frac{904}{3} = 301.3$$

$$s = \sqrt{\frac{\Sigma (X - \bar{X})^2}{N - 1}} = \sqrt{301.3} = 17.36$$

The standard deviation for Class B (17.36) is much higher than for Class A (3.74).

COEFFICIENT OF VARIATION

The standard deviation is used to calculate the coefficient of variation (standard deviation divided by the mean), used in the second step of this tool on page 7. In the example of the two classes, the coefficients of variation would be:

Class A: $\frac{3.74}{82} = .05$

Class B: $\frac{17.36}{82} = .21$

Class A has a low coefficient of variation: student performance is grouped closely around the average. Class B has a much higher coefficient of variation, showing that the average score of 82 reflects extremes in performance.

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